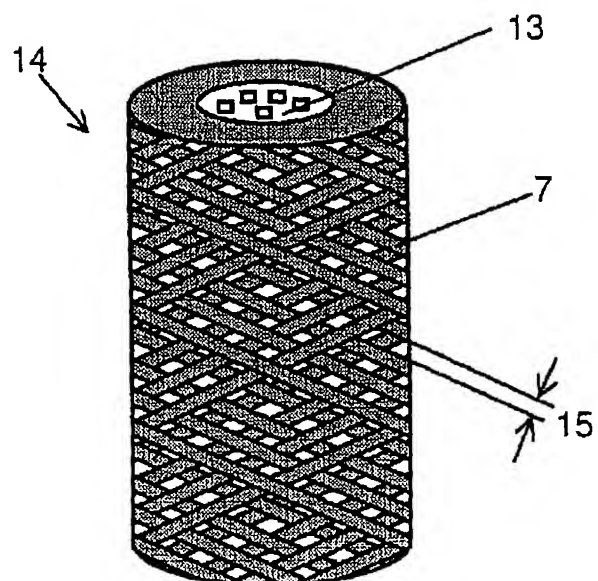


Drawing selection ☐



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CLAIMS

[Claim(s)]

[Claim 1] The filter cartridge which comes to twist around a perforated tube-like object the band-like staple-fiber nonwoven fabric which contained thermoplastic fiber and a part of the fiber intersection [at least] pasted up in the shape of Aya.

[Claim 2] The filter cartridge according to claim 1 which is the mixed nonwoven fabric with other fiber for which this band-like staple-fiber nonwoven fabric contains thermoplastic fiber at least 30% of the weight.

[Claim 3] The filter cartridge according to claim 1 or 2 which is the heat adhesive property bicomponent fiber whose melting point difference of both [these] resins the thermoplastic fiber which constitutes this band-like staple-fiber nonwoven fabric consists of a low melting point resin and a high-melting point resin, and is 10 degrees C or more.

[Claim 4] this low melting point resin -- a line -- the filter cartridge according to claim 3 which is the resin chosen from the copolymer of a low density polyethylene, a low density polyethylene, a high density polyethylene, polypropylene, a propylene, and other alpha olefins, or low melting point polyester

[Claim 5] The filter cartridge according to claim 3 this high-melting point resin of whose is a resin chosen from the copolymer of a high density polyethylene, polypropylene, a propylene, and other alpha olefins, and either of the polyethylene terephthalates.

[Claim 6] The filter cartridge according to claim 1 to 5 to which embossing thermocompression bonding of this band-like staple-fiber nonwoven fabric was carried out.

[Claim 7] The filter cartridge according to claim 1 to 5 by which heat weld of the fiber intersection of this band-like staple-fiber nonwoven fabric is carried out.

[Claim 8] The filter cartridge according to claim 1 to 5 by which the twist was added to this band-like staple-fiber nonwoven fabric.

[Claim 9] The filter cartridge according to claim 1 to 5 which used this band-like staple-fiber nonwoven fabric as the rib-like object which has the rib of 4-50, and was twisted around the perforated tube-like object in the shape of Aya.

[Claim 10] The filter cartridge according to claim 9 a part of rib [at least] of this rib-like object is [filter cartridge] [un-].

[Claim 11] The filter cartridge according to claim 1 to 5 whose voidage of this rib-like object is 60 - 95%.

[Claim 12] The filter cartridge according to claim 1 to 5 whose voidage of this filter cartridge is 65 - 85%.

[Claim 13] The filter cartridge according to claim 1 to 5 which is size as the voidage of this filter cartridge becomes an outer layer from a inner layer.

[Claim 14] The filter cartridge according to claim 1 to 5 whose product of width of face (cm) and eyes (g/m²) the width of face of a band-like staple-fiber nonwoven fabric is 0.5cm or more, and is 200 or less.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention carries out the slit of the filter cartridge for liquid filtration, and the staple-fiber nonwoven fabric which consists of thermoplastic fiber in detail to band-like, and relates to the filter cartridge which twisted this in the shape of Aya.

[0002]

[Description of the Prior Art] Various filters are developed and produced in order to purify a fluid now. Especially, the cartridge type filter (it abbreviates to a filter cartridge below) with easy exchange of a filter is used in the broad field on industries, such as removal of the suspension particle in an industrial use liquid raw material, removal of the cake which flowed out of surface filtration equipment, and purification of industrial water.

[0003] The kind of some [structure / of a filter cartridge / former] is proposed. A spool type filter cartridge is the most typical especially. This is made from twisting the spun yarn which becomes a perforated cylinder-like core with a filtering medium in the shape of Aya, and is used from manufacture being easy and being cheap for many years. There is a nonwoven fabric laminating type filter cartridge as another structure. This is the filter cartridge of the shape of a cylindrical shape which winds gradually some kinds of nonwoven fabrics, such as a carding nonwoven fabric, around a perforated cylinder-like core, and is made, and what combined various kinds of nonwoven fabrics by development of a nonwoven fabric manufacturing technology is put in practical use.

[0004] However, these filter cartridges also have some faults. For example, although it carries out the uptake of the particle by the own aperture of spun yarn and also it carries out the uptake of the particle in the gap of the fluff generated from spun yarn, or spun yarn, since adjustment of the yield of a fluff and the gap of spun yarn effective in filtration is difficult, the particle uptake method of a spool type filter cartridge has a limitation in the kind of filtration accuracy which can be manufactured, and its dispersion in the filtration accuracy of a product is large, and it has the fault that a fine filtration-accuracy division. Moreover, since spun yarn twists a staple fiber and is made, when a fluid flows to a filter cartridge, it also has the fault that the composition fiber of spun yarn drops out.

[0005] Moreover, as for the filter of the structure which wound the double-width nonwoven fabric 1 around the surroundings of the perforated tube-like object 13 as shown in drawing 1 as it was, and the so-called nonwoven fabric laminating type filter cartridge, the filtration efficiency is decided by the nonwoven fabric. The method of making a nonwoven fabric from direct resin, such as a way it heat-treats and makes a staple fiber from a hot blast heating machine, a heating roller, etc. if-needed after carrying out the confounding of the manufacture of a nonwoven fabric with a carding machine, an air RAID machine, etc. or the melt blowing method, and the span bond method, is used in many cases. However, any machine used for nonwoven fabric manufactures, such as a carding machine, an air RAID machine, a hot blast heating machine, a heating roller, a melt blow machine, and a span bond machine, produces the physical-properties unevenness which influences a filtration efficiency in the nonwoven fabric cross direction in many cases according to unevenness, such as eyes and a processing state, in the

machine cross direction. Therefore, a filter cartridge becomes poor [quality], or using the advanced manufacturing technology for abolishing unevenness, a manufacturing cost is high and there is a bird clapper. Moreover, in order that a nonwoven fabric laminating type filter cartridge may raise a filtration efficiency, also in it being necessary to use about 2-6 kinds of nonwoven fabrics from which the voidage per form and the diameter of fiber differ, and using the nonwoven fabric from which a process and a fiber kind differ, for a certain reason, depending on the case, a manufacturing cost becomes high also by it.

[0006] As a method for solving the trouble of such a conventional filter cartridge, adding a twist to tape-like the paper and the nonwoven fabric which have porosity, to JP,6-7767,Y, it crushes and narrows down by letting a taper-like cone pass, and the filter cartridge of the form which wound around the porous container liner the filtration material which regulated the diameter to about 3mm in close Aya is proposed. Moreover, the uptake of the big particle is carried out outside by enlarging the volume pitch of winding as it goes outside a porous container liner, and since the uptake of the small particle can be carried out in a filter-medium core, it is supposed that a filtration operation can be obtained over a long period of time. However, since the filtration material is crushed and narrowed down, the voidage of a filtration material becomes small, the amount of uptakes of the particle incorporated by the filtration material itself becomes small, and dipping nature will also fall. And by the close Aya volume, since the gaps of filtration materials are also few, there is no space which is easy to dip and the dipping nature of the filter itself will fall. Moreover, although it is when the uptake of the big particle is carried out by enlarging an outside volume pitch in the gap of filtration materials, since the area of the gap formed for filtration materials is slight, even if it gives inclination to a gap, since the amounts of particle uptakes are few and it is easy to be blockaded, the filtration life of a filter will become very short.

[0007] The filter which twisted the slit nonwoven fabric to which 10% of the weight or more of composition fiber becomes JP,4-45810,A from the bicomponent fiber currently divided into 0.5 deniers or less as an option so that fiber density might be set to 0.18-0.30 on porous **** is proposed. When this method is used, there is the feature that the fine particle in a liquid can be caught by fiber with small fineness. However, it is difficult for it to be necessary to use the physical stress of high-pressure water etc., in order to make a bicomponent fiber divide, and to make it divide into homogeneity over the whole nonwoven fabric in high-pressure water processing. Since a difference arises in a uptake particle diameter in the part which it is [in a nonwoven fabric] good and was divided, and the part where division is inadequate when not divided uniformly, a filtration accuracy may become coarse. Moreover, since nonwoven fabric intensity may fall with the physical stress to be used in case it divides, the intensity of the made filter falls, it may become, or the voidage of a filter may change that it is easy to deform while in use, and dipping nature may fall. Furthermore, if nonwoven fabric intensity is small, since adjustment of the tension at the time of twisting on porous **** will become difficult, adjustment of delicate voidage is difficult and there is a bird clapper. Furthermore, since the manufacturing cost of a filter becomes high by the spinning technology demanded in order to make ***** fiber, or the operation increase in cost at the time of manufacture, Although it will be thought that it can be used for a part of field as which an advanced filtration efficiency like medicine manufacture industry or electronic industry is required if the technical problem on a filtration efficiency which carried out point ** is solved It is considered for use to be difficult for the use searched for that a filter is cheap like filtration of pool water or filtration of the plating liquid for galvanizer business.

[0008]

[Problem(s) to be Solved by the Invention] As a result of inquiring in order to solve the aforementioned technical problem, by twisting around a perforated tube-like object the staple-fiber nonwoven fabric which consists of thermoplastic fiber in the shape of Aya, the purpose of this invention found out that it was possible to obtain the tubed filter cartridge excellent in the stability of dipping nature, a filtration life, and a filtration accuracy etc., and reached this invention.

[0009]

[Means for Solving the Problem] this invention has the following composition.

(1) The filter cartridge which comes to twist around a perforated tube-like object the band-like staple-

fiber nonwoven fabric which contained thermoplastic fiber and a part of the fiber intersection [at least] pasted up in the shape of Aya.

(2) this -- band-like -- a staple fiber -- a nonwoven fabric -- thermoplasticity -- fiber -- at least -- 30 -- % of the weight -- containing -- others -- fiber -- mixing -- having had -- a nonwoven fabric -- it is -- (-- one --) -- a term -- a publication -- a filter cartridge .

(3) A filter cartridge given in (1) or (2) terms which are the heat adhesive property bicomponent fiber whose melting point difference of both [these] resins the thermoplastic fiber which constitutes this band-like staple-fiber nonwoven fabric consists of a low melting point resin and a high-melting point resin, and is 10 degrees C or more.

(4) this -- low -- the melting point -- a resin -- a line -- a low density polyethylene -- a low density polyethylene -- a high density polyethylene -- polypropylene -- a propylene -- others -- an alpha olefin -- a copolymer -- low -- the melting point -- polyester -- either -- from -- choosing -- having had -- a resin -- it is -- (-- three --) -- a term -- a publication -- a filter cartridge .

(5) this -- a high-melting point -- a resin -- a high density polyethylene -- polypropylene -- a propylene -- others -- an alpha olefin -- a copolymer -- a polyethylene terephthalate -- either -- from -- choosing -- having had -- a resin -- it is -- (-- three --) -- a term -- a publication -- a filter cartridge .

(6) A filter cartridge given in either of the (1) - (5) terms to which embossing thermocompression bonding of this band-like staple-fiber nonwoven fabric was carried out.

(7) A filter cartridge given in either of the (1) - (5) terms by which heat weld of the fiber intersection of this band-like staple-fiber nonwoven fabric is carried out.

(8) A filter cartridge given in either of the (1) - (5) terms by which the twist was added to this band-like staple-fiber nonwoven fabric.

(9) A filter cartridge given in either of the (1) - (5) terms which used this band-like staple-fiber nonwoven fabric as the rib-like object which has the rib of 4-50, and were twisted around the perforated tube-like object in the shape of Aya.

(10) A filter cartridge given in (9) terms a part of rib [at least] of this rib-like object is [terms] [un-].

(11) A filter cartridge given in either of the (1) - (5) terms whose voidage of this rib-like object is 60 - 95%.

(12) A filter cartridge given in either of the (1) - (5) terms whose voidage of this filter cartridge is 65 - 85%.

(13) A filter cartridge given in either of the (1) - (5) terms which are size as the voidage of this filter cartridge becomes an outer layer from a inner layer.

(14) A filter cartridge given in either of the (1) - (5) terms whose products of width of face (cm) and eyes (g/m²) the width of face of a band-like staple-fiber nonwoven fabric is 0.5cm or more, and are 200 or less.

[0010]

[Embodiments of the Invention] Hereafter, the mode of this invention is explained concretely. The filter medium of the filter cartridge of this invention is the band-like staple-fiber nonwoven fabric which consisted of thermoplastic fiber and a part of the fiber intersection [at least] pasted up, and since the fiber intersection has pasted up, it has little defluxion of fiber compared with the spool type filter which used conventional spun yarn. Moreover, since the band-like staple-fiber nonwoven fabric is twisted around the perforated tube-like object in the shape of Aya, there is little filtration-efficiency dispersion of the filter length direction, and it is excellent in productivity. Furthermore, since the rib is attached to the band-like staple-fiber nonwoven fabric, by the increase in voidage of the appearance by having considered as the increase in particle uptake area and rib-like object by the irregularity of a rib, the change width of face of the filter-medium voidage at the time of filter manufacture spreads, there are many kinds of filtration accuracy which can be manufactured and the filter cartridge which was excellent in the filtration life can be offered.

[0011] All the thermoplastics in which melt spinning is possible can be used for the thermoplastic fiber used for this invention. as the example -- polypropylene, a low density polyethylene, a high density polyethylene, and a line -- a low density polyethylene and copolymerization polypropylene (for

example, a propylene is made into a subject) System resins, such as duality or plural copolymers with ethylene, butene-1, and 4-methyl pentene-1 grade including a polyolefine, Polyester system resins including these low melting point polyester that also added the isophthalic acid and copolymerized the polyethylene terephthalate, the polybutylene terephthalate, and the acid component in addition to the terephthalic acid, Thermoplastics, such as polyamide system resins, such as nylon 6 and Nylon 66, polystyrene (atactic polystyrene, syndiotactic polystyrene), a polyurethane elastomer, a polyester elastomer, and a polytetrafluoroethylene, can be shown. Moreover, the resin of functionality can also be used, such as giving biodegradability to a filter cartridge using biodegradability resins, such as lactic-acid system polyester. Moreover, when using the resin which can carry out a polymerization with metallocene catalysts, such as a polyolefine system resin and polystyrene resin, since the property of metallocene resins, such as reduction of improvement in nonwoven fabric intensity, chemical-resistant improvement, and production energy, is harnessed in a filter cartridge, it is desirable. Moreover, in order to adjust the heat adhesive property and rigidity of a staple-fiber nonwoven fabric, you may blend and use these resins. Also in these, when polyolefine system resins including polypropylene use it for comparatively hot liquid preferably from the point of chemical resistance and a price, a polyester system resin, a polyamide system resin, or syndiotactic polystyrene resin is desirable.

[0012] In addition, the thermoplastic fiber which constitutes the staple-fiber nonwoven fabric used by this invention can ensure heat adhesion of the fiber junction of a nonwoven fabric as it is the bicomponent fiber which 10 degrees C or more of 15 degrees C or more of melting point differences become from a certain low melting point resin and high-melting point resin preferably. Although there is especially no upper limit of a melting point difference, the temperature gradient of the resin of the highest melting point and the resin of the minimum melting point corresponds among the thermoplastics in which melt spinning is possible. In addition, in being the resin with which the clear melting point does not exist, it considers that a flow beginning temperature is the melting point. Since the probability that fiber will drop out when fiber deteriorates temporarily with the matter which possibility that the particle caught near the fiber junction when heat adhesion of a fiber junction was performed, a filter cartridge was formed and the amount of filtration pressure or water flow went up would flow out became small, and deformation of a filter cartridge became small, and was further contained in filtrate becomes small, it is desirable.

[0013] The combination of the low melting point resin of this bicomponent fiber, and a high-melting point resin It is not what will be limited especially if there are 15 degrees C or more preferably [10 degrees C or more of melting point differences]. a line -- a low density polyethylene/polypropylene, and a high density polyethylene/polypropylene -- A low density polyethylene/polypropylene, the copolymer/polypropylene of a propylene and other alpha olefins, a line -- a low density polyethylene/high density polyethylene, and a low density polyethylene/high density polyethylene -- Various kinds of polyethylene/polyethylene terephthalates, polypropylene/thermoplastic polyester, Copolymerized polyester/polyethylene terephthalate, various kinds of polyethylene/nylon 6, polypropylene/nylon 6, nylon 6 / Nylon 66, nylon 6/polyethylene terephthalate, etc. can be raised. If the combination of a high density polyethylene/polypropylene is used especially also in the combination of various kinds of polyethylene/polypropylene, since regulation can perform easily the rigidity of a staple-fiber nonwoven fabric, and adjustment of voidage in the fusing process of the fiber intersection at the time of nonwoven fabric manufacture, it is desirable. Moreover, when using it for comparatively hot liquid, the combination of the low melting point polyester / polyethylene terephthalate which copolymerized the terephthalic acid and the isophthalic acid as an acid component to ethylene glycol can also be used suitably.

[0014] Moreover, fiber other than thermoplastic fiber can also be used for the staple-fiber nonwoven fabric used by this invention. As an example, inorganic fibers, such as natural fibers and carbon fibers, such as regenerated fibers, such as rayon and cuprammonium rayon, cotton, hemp, silk, and pulp, and a metal fiber, are mentioned. Although not limited especially about the mixed rate of fiber other than these thermoplasticity fiber, as for the rate included in a nonwoven fabric, thermoplastic fiber needs to be made to be contained at least 30% of the weight. Since the nonwoven fabric intensity at the time of

carrying out the thermal bond of the fiber will fall if the thermoplastic fiber contained in a nonwoven fabric is less than 30 % of the weight, there is a possibility that a nonwoven fabric may fracture according to the force applied at the time of processing at the time of forming a filter cartridge. Furthermore, since the thermal-bond part of a fiber intersection decreases, a possibility of fiber becoming easy to drop out at the time of filtration, and mixing in filtrate comes out.

[0015] Moreover, if eyes are reduced in order for the water flow nature of a staple-fiber nonwoven fabric to fall or to raise water flow nature, if it is too thin, although it is not limited especially, since the diameter of single-yarn fiber of a staple-fiber nonwoven fabric changes with the uses and the filtration accuracies demanded of a filter cartridge, the intensity of a nonwoven fabric will fall. Moreover, since the effect stops showing up if too thick even if a staple-fiber nonwoven fabric becomes very coarse and it makes it a rib-like object, generally it becomes the range of 5-150 micrometers of diameters of fiber.

[0016] Moreover, the composition fiber of a staple-fiber nonwoven fabric does not necessarily need to be a circular cross section, and can also use a sprit fiber and variant cross-section thread. In this case, the uptake of a minute particle increases, so that the surface area of fiber is large, since it is carried out in many cases on the surface of fiber, and it can make a highly precise filter cartridge from the dipping nature more nearly same than the case where the fiber of a circular cross section is used.

[0017] Moreover, since dipping nature will improve in using it for the liquid of a drainage system if mix hydrophilic resins, such as polyvinyl alcohol, with the raw material resin of thermoplastic fiber, or a cellulosic fiber is mixed with cotton to a staple-fiber nonwoven fabric, or plasma etching is performed to a staple-fiber nonwoven face side and a hydrophilic property is raised, it is desirable.

[0018] The staple-fiber nonwoven fabric used for this invention is manufactured from the carding method, the air RAID method, a paper-making method, etc. Since it is also called a web and the fiber intersection has not pasted up, the nonwoven fabric after processing by these methods has weak intensity, and it is difficult to process it into the filter cartridge of this invention with this. It is necessary to raise intensity by giving needle punch processing, water jet-needle processing, etc. to a web, and **** needs to paste up a fiber intersection for preventing the fiber defluxion at the time of filtration. Although there is the method of pasting up a fiber intersection by heat-treatment or carrying out dryness processing after making the solvent and emulsion of a resin used as adhesives permeate a nonwoven fabric by dip coating, the atomizing process, etc. as the adhesion method of a fiber intersection or making a nonwoven fabric sprinkle resin powder, since the filtrate which can be used with thermal resistance, chemical resistance, etc. is limited in many cases, the method of using thermoplastic fiber as a binder and carrying out a thermal bond is desirable.

[0019] The method using heat setting machines, such as the method of carrying out thermocompression bonding as a method of carrying out a thermal bond using equipment like a heat flat calendering-roll machine, a heat embossing-roll machine, or an ultrasonic embossing machine, a hot blast through air type, the vertical direction hot blast jet type, and an infrared heater type, etc. can be mentioned. Especially, since the method using a heat embossing-roll machine has quick thermocompression bonding processing speed, productivity is good and can make a manufacturing cost cheap. In this case, as for the area of embossing thermocompression bonding, it is desirable to carry out to 5 - 30% of a staple-fiber nonwoven surface-of-cloth product. When this area is less than 5%, since the amount of [of a fiber intersection] jointing is few, nonwoven fabric intensity tends to fall and it is in the inclination for defluxion of a filtering medium to increase. Moreover, when 30% is exceeded, it is because it is in the inclination for the dipping nature when considering as a filter to fall. Although it is inferior to productivity about a hot blast through air type-heat setting machine, since a fiber intersection can be pasted up uniformly, it is a method effective in preventing defluxion of a filtering medium. Furthermore, you may let a flat calendering roll pass after a heat setting machine to adjust the band-like voidage and band-like thickness of a staple-fiber nonwoven fabric.

[0020] As for a weight, 5-200g/m² is desirable per eyes of a staple-fiber nonwoven fabric, i.e., a nonwoven fabric unit area. If this value becomes smaller than 5 g/m², since the amount of fiber will decrease, the unevenness of a nonwoven fabric becomes large, or the thermal bond of a fiber intersection in which the intensity of a nonwoven fabric fell or carried out point ** is difficult, and there is a bird

clapper. If this value becomes larger than 200 g/m², since a nonwoven fabric will become thick on the other hand, processing which forms a rib becomes difficult. Moreover, even if the thickness of a nonwoven fabric is thin, since there are few openings of a nonwoven fabric, when it is made a filter cartridge, water flow nature will fall.

[0021] Although the method of adjusting the width of face at the time of web formation, and making a band-like staple-fiber nonwoven fabric as a method of making a staple-fiber nonwoven fabric band-like can also be used, the method of carrying out the slit of the double-width staple-fiber nonwoven fabric to band-like is desirable from productivity or the homogeneity of width of face. Although the slit width at this time changes also with eyes of the nonwoven fabric to be used, if 0.5cm or more is desirable and becomes narrower than 0.5cm, adjustment of the tension at the time of there being a possibility that a nonwoven fabric may fracture, at the time of a slit, and rolling round a band-like nonwoven fabric to Ayakami behind will become difficult. Furthermore, in making the filter of the same voidage, it rolls round, time becomes long and productivity falls. On the other hand, the upper limit of slit width changes with eyes, and it is desirable that the value of slit width (cm) x eyes (g/m²) is 200 or less. When this value became larger than 200, and twisting around a perforated tube-like object and it twists around a perforated tube-like object since the path becomes thick too much when a band-like staple-fiber nonwoven fabric is narrowed down, the space except a staple-fiber nonwoven fabric occupying within a filter layer will surely become large, and regulation of filter layer voidage will become difficult. Moreover, the part and the volume length per filter cartridge who became thick will become short, and the gap formed by band-like staple-fiber nonwoven fabrics will also decrease. Consequently, change of filter layer voidage, regulation of the filtration accuracy by the gap, and improvement in a filtration life will become difficult.

[0022] As an example of a method which makes a rib form in a band-like staple-fiber nonwoven fabric, the method of processing a band-like staple-fiber nonwoven fabric into a rib-like object through a stoma etc., after preforming a rib in a suitable plication guide is mentioned. An example of this manufacturing method is shown in drawing 2. When taking this method, preforming of the cross-section configuration is carried out through the plication guide 5, the band-like staple-fiber nonwoven fabric 2 serves as a rib-like object through the stoma guide 6 continuously, and if the rib-like object is taken over in the direction of A of drawing and it twists around a perforated tube-like object, it will serve as a filter cartridge. The winder used for the usual spool type filter cartridge can be used for the winder for twisting a rib-like object around a perforated tube-like object.

[0023] Next, plication guide ***** explanation is given. A plication guide uses what usually bent and processed the metal wire with a diameter of about 1-3mm, and the thing which clipped the metal plate with a thickness of about 1-3mm. When friction poses a problem, you may give fluororesin processing to a surface of metal. The example of the configuration is shown in drawing 3 -4. The plication guide 5 consists of an external regulation guide 3 and an internal regulation guide 4 in the example given here. Although especially the configuration of the plication guide 5 is not limited, in the cross-section configuration of the rib-like object made from this guide, what is necessary is just the guide configuration which converges so that ribs may not become as parallel as possible. Although the example of the cross-section configuration of the rib-like object made by making it such is shown in drawing 5 (A), (B), and (C), it is not limited to these configurations. In these modes of this invention, the thing in which the rib-like object which converged so that a part of rib [at least] might be unparallel was made to form is the desirable mode of this invention. That is, when a part of rib is unparallel like the cross-section configuration of drawing 5, as shown in drawing 6 (A) and (B), even when filtration pressure is applied to a rib from a perpendicular direction like an arrow compared with the case where most ribs are parallel, the configuration holding power of a rib-like object is strong, and the filtration function by the rib configuration can be held. That is, when a rib is not parallel, in order to maintain the opening of a rib-like object as compared with the case where a rib is parallel, it can be said that it excels in the capacity to suppress the pressure loss of a filter cartridge.

[0024] It does not necessarily need to be one, and if the cross-section configuration of a band-like staple-fiber nonwoven fabric is gradually changed by putting in order in series some guides from which a form

and a size differ, since the cross-section configuration of a rib-like object becomes fixed by the place, the nonuniformity of quality of a rib formation guide is lost, and it is desirable. For example, if it is made to deform so that the number of ribs may increase further by passing the narrower rectangle guide 9 after giving many ribs to a band-like staple-fiber nonwoven fabric using the rib formation guide 8 of Kushigata as shown in drawing 7, a rib can be made arrangement that random it is not parallel.

[0025] In this invention, after using a band-like staple-fiber nonwoven fabric as a rib-like object, when twisting around a perforated tube-like object, the 4-50 final numbers of ribs of a rib-like object are 7-45 pieces more preferably. The number of ribs is deficient in the effect by the filtration area expansion by rib grant in less than four pieces. On the other hand, if the number of ribs exceeds 50 pieces, a rib will become small too much, and it will become manufacture difficulty, and improvement in the filtration efficiency by the increase in the number of ribs will no longer be found.

[0026] Moreover, the cross-section configuration of a rib-like object is fixable by carrying out heating processing of the rib-like object 7 after letting the stoma guide 6 which carried out point ** pass at hot blast or an infrared heater. Although this process is not necessarily required, since it may collapse from the form which the cross-section configuration designed when the cross-section configuration of a rib-like object is complicated or rigidity uses a high thing as a band-like staple-fiber nonwoven fabric, it is desirable to carry out such heating processing.

[0027] On the other hand, after adding a twist to this band-like staple-fiber nonwoven fabric, it can also roll round. In this case, the winder used for the usual spool type filter cartridge can be used for a winder. If a twist is added to a nonwoven fabric, since the voidage of the appearance of a nonwoven fabric can be changed by the number of twists or the strength to twist, a filtration accuracy can be adjusted. [per unit length] The number of twists at this time has 50 - 500 times per 1m of band-like staple-fiber nonwoven fabrics of desirable ranges. If this value becomes smaller than 50 times, the effect by twist will hardly be acquired. Moreover, if this value increases more than 500 times, since a staple-fiber nonwoven fabric will be strong, rat-tail fiber will be got blocked and particle uptake nature will become bad, it is not desirable.

[0028] Next, the voidage of the rib-like object (it abbreviates to a band-like staple-fiber nonwoven fabric convergence object hereafter) with which the band-like staple-fiber nonwoven fabric converged is explained. the egg shape of the minimum area which connotes the band-like staple-fiber nonwoven fabric convergence object 7 for the cross section of a band-like staple-fiber nonwoven fabric convergence object so that it may be shown drawing 8 -- the voidage of a band-like staple-fiber nonwoven fabric convergence object is defined as the area of 10 (an egg shape means the polygon each of each of that interior angle of whose is less than 180 degrees altogether) using the following formula from the cutting length of a band-like staple-fiber nonwoven fabric convergence object

[0029] (Appearance volume of a band-like staple-fiber nonwoven fabric convergence object) = (cutting length of the cross-section x band-like staple-fiber nonwoven fabric convergence object of a band-like staple-fiber nonwoven fabric convergence object)

[0030] (Block style product of a band-like staple-fiber nonwoven fabric convergence object) = (weight of cut band-like staple-fiber nonwoven fabric convergence object) / (density of the raw material of a band-like staple-fiber nonwoven fabric convergence object)

[0031] (Voidage of a band-like staple-fiber nonwoven fabric convergence object) = { 1 - (block style product of band-like staple-fiber nonwoven fabric convergence object) / (appearance volume of band-like staple-fiber nonwoven fabric convergence object) } x 100% [0032] 60 - 95% of the voidage of the band-like staple-fiber nonwoven fabric convergence object defined by this formula is desirable, and it is 80 - 92% more preferably. By making this value into 60% or more, pressure loss when a band-like staple-fiber nonwoven fabric convergence object stops a bird clapper more densely than required and uses it as a filter cartridge can be suppressed enough, and the particle collection efficiency in a band-like staple-fiber nonwoven fabric convergence object can be raised further more. Moreover, by making this value into 95% or less, when it is used as the injury easy next door with a volume to a perforated cylinder object, and a filter cartridge, deformation of the filtering medium by the load pressure can be made smaller. As an example of the method of adjusting this, adjustment of guide configurations, such as

adjustment of rolling-up tension and a rib formation guide, etc. is mentioned.

[0033] Moreover, it is a book when making this band-like staple-fiber nonwoven fabric convergence object. In this case, in order to fix a granular active carbon, ion exchange resin, etc., before processing a band-like staple-fiber nonwoven fabric into convergence or a rib-like object, or after processing it, it may paste up with a suitable binder etc., after making a granular active carbon, ion exchange resin, etc. intermingled, it may heat, and you may carry out heat adhesion with the composition fiber of a staple-fiber nonwoven fabric.

[0034] Next, the perforated tube-like object used for this invention is explained. A perforated tube-like object carries out the duty of the core material of a filter cartridge, and the quality of the material and configuration have the intensity which can bear the external pressure at the time of filtration, and it is not limited especially if pressure loss is not remarkably high. For example, what processed into tubed the stainless steel board which the injection-molded product with a grid-like aperture of a cylindrical shape is sufficient as, and opened many porous ceramics and stomata like the core material of the polyethylene currently used for the usual filter cartridge or the product made from polypropylene does not interfere. Or you may use other filter cartridges, such as a filter cartridge which carried out rib chip box processing, and a nonwoven cloth-beam time type filter cartridge.

[0035] Next, how to twist a band-like staple-fiber nonwoven fabric convergence object around a perforated tube-like object is explained. As a winder, the winder for spool type filter cartridges marketed can be used. After letting the rib formation guide 5 and the stoma guide 6 pass so that the band-like staple-fiber nonwoven fabric 2 may be rolled round in the direction of A as shown in drawing 9, it becomes a filter cartridge 14 by twisting around the perforated tube-like object 13 attached in the direction of B and B' at the spindle 12 which rotates the traverse guide 11 which carries out reciprocating-movement movement in the direction of through and C. It is not necessary to necessarily make into a continuous process the process which makes a filter cartridge from a band-like staple-fiber nonwoven fabric, after forming a band-like staple-fiber convergence object, it is wound around the bobbin, and you may roll it round by the winder behind. Since the thread guide of a winder is shaken in the shape of Aya by the traverse cam installed in parallel with a spindle, the band-like staple-fiber nonwoven fabric aggregate is shaken at a perforated tube-like object in the shape of Aya, and it is twisted around it. What is necessary is just to twist, making it the spindle rotational speed 500 - 2000rpm, adjusting delivery speed that what is necessary is just to also set up the winding conditions at that time according to the time of the usual spool type filter-cartridge manufacture, and applying suitable tension. In addition, the voidage of a filter layer can be changed by changing a setup of a tension adjustment, the rotational frequency of a spindle, etc. at this time. Since it can apply to an outer layer from the inner layer of a filter layer and voidage can be enlarged if these methods are used, improvement in the filtration life by depth type filtration can be aimed at. Moreover, a filtration accuracy can be easily changed not only the kind and composition of a band-like staple-fiber nonwoven fabric convergence object but by adjusting the ratio of the reciprocating-movement speed of a traverse cam, and the rotational speed of a bobbin, and changing a volume pattern. The method of the well-known usual spool type filter cartridge can already be used for how to attach a volume pattern. As shown in drawing 10, when the interval 15 of thread (it is a band-like staple-fiber nonwoven fabric convergence object in the case of this invention) and the thread wound around the layer under one of them is large, a filtration accuracy becomes coarse, and a filtration accuracy becomes fine in being conversely narrow. Moreover, generally as the number of winds (number which a spindle rotates while a traverse guide moves 25cm), three to 5 rotation is used. By these methods, a band-like staple-fiber nonwoven fabric convergence object is twisted to an about 3 times [of the outer diameter of a perforated tube-like object / 1.5 times to] outer diameter, and it is made a filter cartridge. By this method, since the ratio of the reciprocating-movement speed of a traverse guide and the rotational speed of a spindle is adjusted and a volume pattern can be changed, the filter cartridge of various performances can be made from the same band-like staple-fiber nonwoven fabric aggregate. Moreover, about the end face of a filter, a winding-up ***** state is still sufficient, and it may carry out sticking the gasket of polyethylene foam with a thickness of about 3mm etc., and you may process it so that the adhesion of a

filter-cartridge end face and housing may be raised.

[0036] Thus, as for the voidage of ***** formed by the band-like staple-fiber nonwoven fabric convergence object, in the made filter cartridge, it is desirable that it is 65 - 85% of range. When this value becomes smaller than 65%, since fiber density becomes high too much, it is in the inclination for dipping nature to become bad. On the contrary, when this value becomes larger than 85%, it is to become easy to produce the problem of the particle which the filter cartridge transformed when filtration pressure was high, or carried out the uptake at once by the intensity of a filter layer becoming weak flowing into filtrate. Moreover, when the voidage of a filter layer is changed and voidage by the side of an outer layer is made high, and it divides in the range equally divided into three in the thickness direction of a filter layer and considers as a inner layer, an interlayer, and an outer layer, 3 - 15% of range has the desirable difference of the voidage of a inner layer and an outer layer. If smaller than 3%, since there are few differences of voidage, improvement in a filtration life will not be found, and if larger than 15%, in order to concentrate on the layer which whose difference of voidage is too large conversely and has the uptake of a particle, improvement in a filtration life is not obtained in this case, either. Since the range of the voidage of each class was mentioned above, its voidage within the limits of the whole filter layer is desirable.

[0037] In addition, dipping nature and a collection efficiency are improvable by putting a break into a band-like staple-fiber nonwoven fabric beforehand, or making a hole. In this case, about 5-100 pieces are suitable for it per 10cm of band-like staple-fiber nonwoven fabrics, and when making a hole, it is appropriate for the number of breaks to make the rate of a puncturing aspect product about 10 - 80%. If less than a lower limit, an effect will not show up, respectively, and if it exceeds a upper limit, nonwoven fabric intensity will become weak, or the fall of a filtration accuracy will arise. Moreover, it can consider as plurality or combining the number of the band-like staple-fiber nonwoven fabric when rolling round with other thread, such as spun yarn, and twining it can also adjust a filtration efficiency. Moreover, as shown in drawing 11, after twisting a band-like staple-fiber nonwoven fabric convergence object to a certain amount of path and forming a inner layer 16, you may use the method of making involve in a nonwoven fabric double-width by the middle, forming the insertion nonwoven cloth layer 17, twisting a band-like staple-fiber nonwoven fabric convergence object by reciprocating movement continuously, and forming an outer layer 18. If this method is enforced when a thread interval is made large and twisted, and the collection efficiency of a particle is not fully obtained, it can adjust a collection efficiency easily.

[0038]

[Example] Below, although this invention is explained still in detail, this invention is not limited to these examples by an example and the example of comparison. In addition, in each example, evaluation of the physical properties of a filter medium, a filtration efficiency, etc. was performed by the method of indicating below.

[0039] (Eyes and thickness) The nonwoven fabric was cut out from three places so that the area of a nonwoven fabric might be set to 2 625cm, and the weight was measured, it converted into the weight per square meter, and the average was made into eyes (g/m²). Moreover, five thickness of a nonwoven fabric was arbitrarily measured with the thickness measurement machine, and the average was made into the thickness (mm) of a nonwoven fabric. In addition, the gauge head of a thickness measurement machine is 20mm in diameter, and added the load of 10 g/cm².

[0040] (Diameter of fiber) Five places were sampled at random from the nonwoven fabric, they were photoed with the scanning electron microscope, 20 fiber per place was chosen at random, those diameters of fiber were measured, and the average was made into the diameter (micrometer) of fiber of the nonwoven fabric.

[0041] (The number of ribs of a band-like staple-fiber nonwoven fabric convergence object) After fixing a band-like staple-fiber nonwoven fabric convergence object with epoxy system adhesives, five places were cut in arbitrary positions and a photograph of the cross section was taken under the microscope. From the photograph, in any [of a mountain chip box or a valley chip box] case, the number of the folds of a band-like staple-fiber nonwoven fabric convergence object was counted as one, and 1/2 of the

cut number of averages of five places was made into the number of ribs.

[0042] (Voidage of a band-like short ***** convergence object) After fixing the cross-section configuration of a band-like staple-fiber nonwoven fabric convergence object with epoxy system adhesives, five places were cut in arbitrary positions and a photograph of the cross section was taken under the microscope. Image analysis of the photograph was carried out, and it asked for the cross section of a band-like staple-fiber nonwoven fabric convergence object. Moreover, the band-like staple-fiber nonwoven fabric convergence object of a part different from this was cut in length of 10cm, and it asked for voidage (%) using the following formula from the weight and the cross section for which it asked previously.

(Appearance volume of a band-like staple-fiber nonwoven fabric convergence object) = (cutting length of the cross-section x band-like staple-fiber nonwoven fabric convergence object of a band-like staple-fiber nonwoven fabric convergence object)

(Block style product of a band-like staple-fiber nonwoven fabric convergence object) = (weight of band-like staple-fiber nonwoven fabric convergence object) / (specific gravity of the raw material of a band-like staple-fiber nonwoven fabric convergence object)

(Voidage of a band-like staple-fiber nonwoven fabric convergence object) = { 1 - (block style product of band-like staple-fiber nonwoven fabric convergence object) / (appearance volume of band-like staple-fiber nonwoven fabric convergence object) } x 100% [0043] (Thread interval) Ten intervals per filter cartridge (shown in 15 of drawing 10) with the band-like staple-fiber nonwoven fabric convergence object wound around the layer under one of them in parallel to the band-like staple-fiber nonwoven fabric convergence object (or filamentose object twisted around the perforated tube-like object in the following examples) in a surface were measured, and the average was made into the thread interval (mm).

[0044] (Voidage of a filter layer) The outer diameter of a filter cartridge, a bore, length, and the weight were measured, and it asked for voidage (%) using the following formula. In addition, in order to ask for the voidage of only a filter layer, the perforated tube-like object outer diameter was used for the filter layer bore, and the value which subtracted the perforated tube-like object weight from the filter-cartridge weight was used for the value of a filter layer weight.

= $\pi \{ (\text{Appearance volume of a filter layer}) (\text{Filter-cartridge outer diameter})^2 - (\text{filter layer bore})^2 \} \times (\text{filter-cartridge length}) / 4 (\text{block style product of filter layer}) = (\text{filter layer weight}) / (\text{density of filter layer raw material}) (\text{voidage of filter layer}) \} \{ \text{appearance volume of 1 - (block style product of filter layer) / filter layer} \} \times \text{-- in addition 100\%}$ When the inclination of voidage was given to a filter layer, it is measuring the weight and outer diameter of a band-like staple-fiber nonwoven fabric convergence object after undoing and undoing every [of filter layer thickness / 3 / 1/], and a band-like staple-fiber nonwoven fabric convergence object, and the voidage of a inner layer, an interlayer, and an outer layer was calculated.

[0045] (A filtration accuracy, pressure loss, filtration life) One filter cartridge with a length of 250mm is attached in housing of a circulating filtration-efficiency testing machine, with a pump, a flow rate is adjusted to 30l./m, and water flow circulation is carried out. The pressure differential of the housing entrance side at this time and an outlet side was measured, and it considered as pressure loss (MPa). Next, eight sorts of the test powder I set to the water through which it circulates JIS 8901 (it abbreviates to eight sorts of JIS.) Z Median diameter: They are said 7 kinds (it abbreviates to seven sorts of JIS.) as 6.6-8.6 micrometers. Median diameter: Carry out continuation addition of the cake which mixed 27-31 micrometers by the weight ratio 1:1 by part for 0.5g/, and extract an undiluted solution and filtrate after [of an addition start] 5 minutes. After diluting the extracted liquid with a suitable scale factor, the collection efficiency for every particle size was computed for the particle number for every particle size contained in each liquid using the optical interception formula particle detector. Next, the value was interpolated and it considered as the initial filtration accuracy (micrometer) in quest of the particle size which shows 80% of collection efficiencies. Furthermore, the cake was added, when pressure loss reached 0.2MPa(s), an undiluted solution and filtrate were extracted, same measurement was performed, and it asked for the filtration accuracy (micrometer) at the time of 0.2MPa(s). Moreover, time until it

reaches 0.2MPa(s) from a cake addition start was made into the filtration life (minute).

[0046] (Fiber omission) One filter cartridge with a length of 250mm is attached in housing of a circulating filtration-efficiency testing machine, a flow rate is adjusted to 10l./m with a pump, and it lets ion exchange water flow. 0.5 of the l. which extracted 5l. of initial filtrate at the housing outlet -- a nitrocellulose filter paper with 0.8 micrometers [of apertures], and a diameter of 25mm -- filtering -- a filter paper top -- fiber with a length of 1mm or more made [20 or more of O and the case of four or less / a certain case] ** and the case of 5-9 O for x and the case of 10-19, and fiber omission were judged

[0047] (Example 1) As a band-like staple-fiber nonwoven fabric, it consisted of a polypropylene fiber and 0.22mm in eyes 30.5 g/m² and thickness, 18 micrometers of diameters of fiber, 4cm of slit width, and 15% of the nonwoven surface-of-cloth product used the nonwoven fabric by which thermocompression bonding was carried out by the heat embossing roll. Moreover, the injection molding article made from polypropylene with the bore of 30mm, an outer diameter [of 34mm], and a length of 250mm was used as a perforated tube-like object. When twisting a band-like staple-fiber nonwoven fabric around a perforated tube-like object by the winder, eight ribs and the band-like staple-fiber nonwoven fabric convergence object of 87% of voidage were formed by letting the rib formation guide of the configuration shown in drawing 3 before a traverse guide pass. By spindle rotational frequency 1000rpm, this was rolled round until it became the outer diameter of 62mm to the perforated tube-like object, and the cylinder-like filter cartridge of the thread interval of 0.7mm and 79% of filter layer voidage was obtained. The measurement result of a filtration efficiency is shown in Table 1.

[0048]

[Table 1]

	初期圧力損失 (MPa)	初期捕集粒径 (μ m)	0.2MPa時 捕集粒径 (μ m)	濾過ライフ (分)	繊維脱落性
実施例1	0.004	11	13	221	○
実施例2	0.003	10	12	284	○
実施例3	0.002	11	12	316	◎
実施例4	0.002	12	13	357	◎
実施例5	0.012	5	6	173	◎
実施例6	0.009	5	6	192	◎
比較例1	0.003	17	23	235	×
比較例2	0.006	9	12	181	○
比較例3	0.020	6	8	156	△

[0049] (Example 2) It consisted of fiber which mixed with cotton at 50 % of the weight of polyethylene terephthalate fibers, and 50 % of the weight of rayon fiber as a band-like staple-fiber nonwoven fabric, and 0.23mm in eyes 31.2 g/m² and thickness, 16 micrometers of diameters of fiber, 4cm of slit width, and 15% of the nonwoven surface-of-cloth product used the nonwoven fabric by which thermocompression bonding was carried out by the heat embossing roll. Moreover, the injection molding article made from polypropylene of an-example 1 was used as a perforated tube-like object. When twisting a band-like staple-fiber nonwoven fabric around a perforated tube-like object by the winder, 12 ribs and the band-like staple-fiber nonwoven fabric convergence object of 89% of voidage were formed by letting the rib formation guide of the configuration shown in drawing 3 before a traverse guide pass. By spindle rotational frequency 1000rpm, this was rolled round until it became the outer diameter of 62mm to the perforated tube-like object, and the cylinder-like filter cartridge of the thread interval of 0.6mm and 79% of filter layer voidage was obtained. The measurement result of a filtration

efficiency is shown in Table 1. The uptake area of a band-like staple-fiber nonwoven fabric convergence object increased, and the filtration life improved from the example 1 because the number of ribs increased.

[0050] (Example 3) It consisted of a **** type bicomponent fiber of the weight ratio 5:5 which used the high density polyethylene for the sheath side, and used polypropylene for the heart side as a band-like staple-fiber nonwoven fabric, and it is 0.25mm in eyes 29.6 g/m² and thickness, 17 micrometers of diameters of fiber, and 4cm of slit width, and the fiber intersection used the nonwoven fabric by which the thermal bond was carried out with the heat through air type heat setting machine. Moreover, the injection molding article made from polypropylene of an example 1 was used as a perforated tube-like object. When twisting a band-like staple-fiber nonwoven fabric around a perforated tube-like object by the winder, 12 ribs and the band-like staple-fiber nonwoven fabric convergence object of 90% of voidage were formed by letting the rib formation guide of the configuration shown in drawing 3 before a traverse guide pass. By spindle rotational frequency 1000rpm, this was rolled round until it became the outer diameter of 62mm to the perforated tube-like object, and the cylinder-like filter cartridge of the thread interval of 0.5mm and 80% of filter layer voidage was obtained. The measurement result of a filtration efficiency is shown in Table 1. Since the thermal-bond point increased by having processed it with the heat through air type heat setting machine, omission of fiber decreased compared with the example 2.

[0051] (Example 4) As a band-like staple-fiber nonwoven fabric, it became from the **** type bicomponent fiber using the low melting point polyester (185 degrees C of melting points) which is ethylene glycol / terephthalic acid (75-mol %) / isophthalic-acid (25-mol %) copolymer at the polyethylene-terephthalate and sheath side at the heart side, and it is 0.26mm in eyes 33.2 g/m² and thickness, 21 micrometers of diameters of fiber, and 4cm of slit width, and the nonwoven fabric to which the thermal bond of the fiber intersection be carried out with the Moreover, the injection-molded product made from a polybutylene terephthalate was used with the same size as an example 1 as a perforated tube-like object. When twisting a band-like staple-fiber nonwoven fabric around a perforated tube-like object by the winder, the band-like staple-fiber nonwoven fabric convergence object with 12 ribs was formed by letting the rib formation guide of the configuration shown in drawing 3 before a traverse guide pass. The cut water rolled 10 Ns of tension at the time of rolling up, and the end is making it change gradually with 2 Ns, and obtained the cylinder-like filter cartridge the outer diameter of 62mm and whose thread interval are 0.5mm and 82% of filter layer voidage. The voidage of a inner layer, an interlayer, and an outer layer was 79%, 81%, and 84%, respectively. The measurement result of a filtration efficiency is shown in Table 1. By gathering voidage, depth type filtration went to the outer layer from the inner layer, and the filtration life improved rather than the example 3.

[0052] (Example 5) as a band-like staple-fiber nonwoven fabric -- a sheath side -- a line -- it consisted of a **** type bicomponent fiber of the compound ratio 5:5 which used polypropylene for the low-density-polyethylene (125 degrees C of melting points), and heart side, and it is 0.30mm in eyes 32.6 g/m² and thickness, 23 micrometers of diameters of fiber, and 5cm of slit width, and the nonwoven fabric to which the thermal bond of the fiber intersection was carried out with the heat through air type heat setting machine was used Moreover, the injection molding article made from polypropylene of an example 1 was used as a perforated tube-like object. First, 16 ribs and the band-like staple-fiber nonwoven fabric convergence object of 87% of voidage were formed by winding around a bobbin, after letting the rib formation guide group of composition of that a band-like staple-fiber nonwoven fabric is shown in drawing 7 pass and hanging a twist of 200 times per m with a twisting machine. Next, it let out the band-like staple-fiber convergence object from this bobbin, it rolled round until it became the outer diameter of 62mm to the perforated tube-like object by spindle rotational frequency 1000rpm by the winder, and the cylinder-like filter cartridge whose thread intervals are 0.3mm and 77% of filter layer voidage was obtained. The measurement result of a filtration efficiency is shown in Table 1. The filtration accuracy became high by the voidage of a band-like staple-fiber convergence object falling, and winding densely by having applied the twist.

[0053] (Example 6) as a band-like staple-fiber nonwoven fabric -- a sheath side -- a line -- 70 % of the

weight of **** type bicomponent fibers and 30 % of the weight of cotton of the weight ratio 5:5 which used polypropylene for the low-density-polyethylene (125 degrees C of melting points) and heart side mixed with cotton, it is 0.29mm in eyes 33.1 g/m² and thickness, 21 micrometers of diameters of fiber, and 5cm of slit width, and the nonwoven fabric to which the thermal bond of the fiber intersection was carried out with the heat through air type heat setting machine was used Moreover, the injection molding article made from polypropylene of an example 1 was used as a perforated tube-like object. First, 16 ribs and the band-like staple-fiber nonwoven fabric convergence object of 86% of voidage were formed by winding around a bobbin, after letting the rib formation guide group of composition of that a band-like staple-fiber nonwoven fabric is shown in drawing 7 pass and hanging a twist of 200 times per m with a twisting machine. Next, it let out the band-like staple-fiber convergence object from this bobbin, it rolled round until it became the outer diameter of 62mm to the perforated tube-like object by spindle rotational frequency 1000rpm by the winder, and the cylinder-like filter cartridge whose thread intervals are 0.2mm and 76% of filter layer voidage was obtained. The measurement result of a filtration efficiency is shown in Table 1. Water flow nature improved rather than the increase of a hydrophilic property, and the example 5 by mixing the cotton which is a cellulosic fiber.

[0054] (Example 1 of comparison) The spun yarn made from polypropylene with a diameter of 2mm which spinned the fiber of fineness 3dtex instead of the band-like staple-fiber nonwoven fabric convergence object was used, it rolled round until it became the outer diameter of 62mm to the same perforated tube-like object as an example 1 by spindle rotational frequency 1000rpm, and the cylinder-like filter cartridge of the thread interval of 1.0mm and 77% of filter layer voidage was obtained. The measurement result of a filtration efficiency is shown in Table 1. Although water flow nature and the filtration life were as near as the example 1, initial uptake particle size was quite large, and at the time of 0.2MPa, uptake particle size also became still larger and it became a filter inferior to an example 1. Moreover, there were very many omission of a filtering medium.

[0055] (Example 2 of comparison) while carrying out the slit of the staple-fiber nonwoven fabric of an example 1 to 25cm width of face and adding the load of linear pressure 1 kg/cm to the same perforated tube-like object as an example 1 -- until -- it twisted and the cylinder-like filter cartridge of the outer diameter of 62mm and 76% of filter layer voidage was obtained The measurement result of a filtration efficiency is shown in Table 1. Although initial uptake particle size was smaller than the example 1 a little, water flow nature and the filtration life were inferior.

[0056] (Example 3 of comparison) JIS cut in width of face of 5cm instead of the band-like staple-fiber nonwoven fabric convergence object P One sort of filter papers set to 3801 were used. first, this band-like filter paper -- the metal of the diameter cm of an entrance, and 0.5cm of diameters of an outlet -- the funnel was wound around the bobbin after hanging the twist of 200 times per m with through Next, it let out from the bobbin the filter paper by which twisting was carried out, it rolled round until it became the outer diameter of 62mm to the perforated tube-like object by spindle rotational frequency 1000rpm, and the cylinder-like filter cartridge whose thread intervals are 0.2mm and 73% of filter layer voidage was obtained. The measurement result of a filtration efficiency is shown in Table 1. Initial-pressure loss was large and the filtration life was also inferior to an example 5 in it. Moreover, there were a little many omission of a filtering medium.

[0057]

[Effect of the Invention] Compared with the spool type filter cartridge of the former [filter cartridge / of this invention], it can catch to a fine particle, and a filtration life is long, and change of initial uptake particle-size is hardly seen, but what has low pressure loss is obtained. Moreover, it is stabilized without crushing a rib-like object, since it is hard to receive the filtration pressure of a rib and a perpendicular direction even if a rib compares with an parallel rib-like object, when the rib-like object of the band-like continuous-glass-fiber nonwoven fabric converged so that a part of rib [at least] might become un-parallel is used, and a filtration efficiency can be maintained.

[Translation done.]